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Effect of Antibiotics in the Diets of Sows During Farrowing and Lactation[1]

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Infections resulting in partially resorbed fetuses, metritis-mastitis complex, agalactia, or other diseases involved in the reproduction of swine appear to be on the increase. Microorganisms that affect the health of young pigs seem omniactive. Their number and virulence appear to build up rapidly, thus necessitating frequent cleaning up of intensively used farrowing houses. The etiological agents involved in many of these diseases have not been clearly defined. Generally, they are thought to be carried in the reproductive tract and lower gut of the sow. It seems likely, then, that high-level feeding of antibiotics that are effective over a wide spectrum of microorganisms would have a prophylactic effect against many of these pig production problems. It also seems likely that different responses to antibiotic use would depend upon the build-up in number and virulence of microorganisms in the environment, which, in turn, would depend upon the uniformity of antibiotic treatment of animals in that environment.

The objectives of these studies were (1) to determine whether antibiotics in the feed of sows during and following the farrowing period would alter the pathogenic microorganism population in the sow and the baby pig, (2) to compare the effect of different antibiotics under varying environmental conditions, and (3) to compare the technique of uniform antibiotic treatment of all sows within a house, that is, treatment by house groups, with the commonly used technique of comparing different treatments within a given house.

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EXPERIMENTAL METHOD

Fifty-six sows at two experiment station farms in Virginia, 30 sows on a cooperating commercial farm in Virginia, and 116 sows on a cooperating commercial farm in Hawaii were used in the studies reported here. Crossbred sows of varying combinations of Hampshire, Duroc, and Yorkshire breeding were used. Farrowing crates on concrete-floored pens with each pen unit separated by concrete dividers were used on one of the Virginia experiment stations and the Hawaii farms. The test on one experiment station farm and the commercial farm in Virginia was conducted in environmentally regulated houses in which sows were farrowed in crates on slotted floors. Sows were moved into the crates on the 109th day after breeding. They were grouped according to age and breeding date and the groups were randomly assigned to treatment lots.

At the experiment station farms in Virginia (trial 1), sows were placed on treatment 4 days before they were moved into the cleaned house. Half (28) of the sows were placed on a 15-percent protein, fortified corn-soybean meal diet with no antibiotic, which was considered the basal diet, and the other half was placed on the same diet except that it contained 166 mg. active neomycin and 166 mg. oxytetracycline per kg. of feed. They were fed at the rate of 2.3 kg. feed per head daily until farrowing. After farrowing, the feed was increased daily to a maximum feed allowance in approximately 6 days. The maximum feed allowance consisted of 2.8 kg. of feed for the first 6 pigs plus 0.5 kg. for each additional pig. Antibiotic was included in the feed until 10 days after farrowing. Pigs were weighed individually at birth and when weaned at 28 days of age.

The 30 sows in trial 2, conducted on the Virginia commercial farm, were started on experimental diets when they were moved into the house. Ten of the sows received only the basal corn-soybean meal diet; another 10 sows received the basal diet plus 166 mg. neomycin sulfate and 166 mg. oxytetracycline per kg. feed. The remaining 10 sows were fed the basal diet plus 110 mg. chlortetracycline, 110 mg. sulfamethazine, and 55 mg. procaine penicillin per kg. feed. Sows were self-fed from the time they were moved into the farrowing house and the antibiotics were kept in the feed until 10 days after farrowing.

Four sets of swabs were taken from the anus and vagina of each sow. The first set was taken before treatments were begun at the time sows were moved into the house. The second set was taken 2 days later. The third set was taken on the 4th day after starting the antibiotic feed. The fourth and last set was taken the day after farrowing. Sterile swabs were guided into the anus or vagina through a sterile glass canula to vaoid contamination from the outside. Each swab was placed in a sterile tube containing thioglycolate

medium for transportation to the laboratory. Blood agar plates and eosin methylene blue agar plates were inoculated and then incubated at 37° C. aerobically overnight in order to test the flora. Sensitivity checks using commercially available antibiotic discs were made periodically in an effort to detect any change in sensitivity to the antibiotics used.

In a third trial conducted on a commercial farm in Hawaii, 116 sows were used in a replicated trial using five different 12-unit farrowing houses in each replication. Each unit within the house consisted of a 2. x 2.2 m. pen equipped with a standard-type farrowing crate. The units were divided with solid partitions. Sows were moved into the crates on the 110th day of gestation and kept there until pigs were weaned at 23 days of age. At weaning time, each house was vacated, cleaned, disinfected, and left vacant for one week. The second replicate was then started. After farrowing, sows were fed all they would consume of a commercial 15-percent protein diet in two daily feedings. The antibiotic treatment was started at the first feeding after farrowing. It was fed as a top dressing over the feed. In four of the houses, all sows within a house were given the same treatment, while in the fifth house the four treatments were assigned alternately to the sows within the house. The treatments were: (1) Control, (2) 500 mg. active tylosin (in tylosin phosphate) per sow daily, (3) 500 mg. chlortetracycline per sow daily, and (4) 200 mg. chlortetracycline, 200 mg. sulfamethazine, and 100 mg. procaine penicillin per sow daily.

Pre-starter and starter diets were made available *ad libitum* to baby pigs on each trial commencing at 7 days of age.

An analysis of covariance was made on the data from each trial. The data were adjusted for differences due to number of live pigs born, birth weight, and sex of individual pigs. Kramer's (1957) extension of Duncan's (1955) multiple range test was applied to locate interlot differences.

TABLE 1. Effect of neomycin sulfate and oxytetracycline in the sow diet at farrowing on sow and pig performance

ITEMS	BASAL	BASAL + NEOMYCIN SULFATE AND OXYTETRACYLINE
No. of sows	28	28
No. of live pigs farrowed per sow	10.4	10.3
Birth weight per pig, kg.	1.49	1.43
No. of pigs weaned per sow	7.4	7.8
Rate of survival, %	68.3	75.7
Weaning wt. at 28 days, kg.	7.2	7.2

RESULTS AND DISCUSSION

Table 1 shows the results of trial 1 conducted with the experiment station herds. There was no difference in weaning weight due to treatment. Differences in survival were not significant. Although survival rate appears rather low, no disease outbreak was apparent, little or no diarrhea was observed, and no metritis or agalactia appeared. Rate of gain of the pigs was quite uniform within litters.

Results from the second trial conducted on the Virginia commercial farm with two antibiotic combinations are shown in tables 2 and 3. The pigs from sows fed either a combination of neomycin sulfate and oxytetracycline or chlortetracycline, sulfamethazine, and penicillin gained faster ($P < .05$) than pigs from control sows. The mean percentage of survival was greater among the treated pigs but these differences were not significant.

Microbiological studies of the vaginal and intestinal flora failed to show significant changes due to antibiotic feeding (table 3). There was a considerable decrease in the number of hemolytic streptococci picked up by the swabs on the second day after sows of all treatments were moved into the house. The cause of this is not apparent and the count generally returned to a high level on the fourth day after treatment started. This could not be due to time differences since all sows were not moved into the house at one time. *E. coli* organisms were numerous and tended to predominate the plates under all treatments. A trend toward reduced numbers of microorganisms other than *E. coli* and hemolytic streptococci appeared under the neomycin-oxytetracycline treatment but these other organisms were not found consistently in either the treatment or the control sows. No change in sensitivity to antibiotics was detected.

TABLE 2. Effect of two antibiotic combinations on sow and pig performance

ITEMS	BASAL	NEOMYCIN AND OXYTETRACYCLINE	CHLORTETRACYCLINE, SULFAMETHAZINE AND PENICILLIN
No. of sows	10	10	10
No. of live pigs farrowed per sow	10.7	10.2	10.8
No. of pigs weaned per sow	9.0	8.9	9.5
Rate of survival, %	84.1	87.3	88.0
Av. weaning wt. per pig, kg. (28 days)	6.2[a]	6.7[b]	6.8[b]

[a, b] Means on the same line bearing different superscript letters differ significantly ($P < .05$).

TABLE 3. Effect of antibiotic on microflora of anus and vagina of sows (percentage of plates with organism)

ORGANISM	ANUS MICROFLORA				VAGINA MICROFLORA			
	0 days*	2 days*	4 days*	Post-farrow	0 days*	2 days*	4 days*	Post-farrow
				Control				
E. coli	100	89	89	89	78	44	89	89
Hem. strep.	44	0	33	44	44	11	44	44
Non Hem. strep.	0	0	0	0	0	0	0	11
Staph.	11	0	11	11	0	0	22	11
Bacillus S.	0	11	0	0	0	56	11	0
Proteus	0	0	0	11	0	0	0	11
Other**	21	0	0	0	22	0	22	0
				Neomycin and Oxytetracycline				
E. coli	100	100	78	78	67	100	78	89
Hem. strep.	67	11	33	33	33	0	22	24
Non Hem. strep.	0	0	0	0	0	0	0	0
Staph.	0	0	11	0	0	0	0	11
Bacillus S.	0	11	0	0	0	0	0	0
Proteus	0	0	0	0	0	0	0	22
Other**	0	0	11	0	0	0	11	11
				Chlortetracyline, Sulfamethazine and Penicillin				
E. coli	100	100	89	89	78	89	89	56
Hem. strep.	44	11	0	33	78	0	44	56
Non Hem. strep.	11	0	22	22	11	0	11	22
Staph.	11	0	11	11	11	11	0	11
Bacillus S.	0	36	0	0	0	11	0	0
Proteus	0	0	0	22	0	0	22	44
Other**	0	11	0	11	0	0	0	11

* Indicates day swab was taken.
** Other include Coliform, Cornea bacterium, Pasteurella, and Gram neg. cocci.

A summary of the data from trial 3 is given in table 4. Differences in weaning weight of pigs due to sow treatment were significant between the combination antibiotic treatment and other treatments or controls. This held true whether the analyzed data were only from pigs from litters of sows held in one house and treated the same or whether the data were from both study techniques and pooled before analysis. When only data from litters of sows treated by house were included in the analysis, the survival

TABLE 4. Effect of three antibiotic treatments and two comparison techniques on sow and pig performance

	TREATMENT BY HOUSE				TREATMENT BY SOW WITHIN HOUSE			
	Control	Tylosin	Chlor-tetracycline	Chlortetracycline sulfamethazine p. penicillin*	Control	Tylosin	Chlor-tetracycline	Chlortetracycline sulfamethazine p. penicillin*
Level per sow per day, mg.		500	500	500		500	500	500
No. of sows	22	23	23	24	6	6	6	6
No. of live pigs per litter	9.6	9.0	9.5	9.1	10.2	8.7	8.3	9.0
No. weaned	7.4	8.5	7.7	7.8	8.8	7.7	8.2	7.3
Rate of survival, %	78[a]	95[c]	81[ab]	85[b]	87	88	98	81
Weaning wt. per pig, kg. (28 days)	6.3[a]	6.9[a,b]	6.6[a,b]	7.2[b]	7.4	7.0	6.6	7.2

[a,b,c] Means on the same line bearing different superscript letters differ significantly ($P<.05$).

* Chlortetracycline = 200 mg.
Sulfamethazine = 200 mg.
Procaine penicillin = 100 mg.

of pigs from sows fed either tylosin or the antibiotic combination was significantly greater ($P < .05$) than that of the controls. When data from all sows were combined by treatment, however, only the survival rate of the pigs from tylosin-fed sows remained significantly higher than that of the controls.

The technique used to compare treatments appeared to make a difference in this study. The pigs from control sows that received no antibiotic but were kept in the house where other animals did receive antibiotic grew faster than pigs in the house where no antibiotic was used. This could be due to a reduced buildup and spread of pathogenic organisms over the entire house. The weaning weight and the survival rate of pigs from these sows did not differ significantly from those of pigs from sows fed antibiotic. When all sows in the house received no antibiotic, however, weaning weight and survival rate of their pigs were less than those of pigs from sows fed antibiotic. The differences in weaning weight were statistically significant ($P < .05$) only between the controls and those receiving the combination antibiotic.

There was no apparent influence of dietary treatment of sows on the incidence of diarrhea in baby pigs in these studies. Some diarrhea among pigs under all treatments in each trial was observed; however, diarrhea was never severe.

Benefit from antibiotic fed to sows appears to vary under different conditions. This was apparent in these trials as in the published literature. De Pape *et al.* (1953), Carpenter *et al.* (1953), and Davey *et al.* (1955) found no beneficial effects on reproductive performance of sows or growth and survival of their pigs from antibiotic administered to the sows. Mayrose *et al.* (1964), on the other hand, found that sows fed tylosin phosphate weaned a greater number of pigs, and Jordan and Waitt (1963) found heavier weaning weights and higher survival rates among pigs from sows fed 500 mg. tylosin daily.

The mode of action or mechanism through which antibiotic was effective in the trials was not apparent since the microflora of the anus or vagina revealed no significant qualitative change in the number or ratio of pathogenic organisms. There was also no apparent difference in the level of diseases prevalent among sows or pigs from the different treatment groups.

SUMMARY

Three trials involving 200 sows and their litters were conducted (1) to determine the prophylactic effect of antibiotic when given in the sow feed during and following farrowing, (2) to compare the prophylactic effect of different antibiotics and antibiotic combinations, and (3) to compare the

technique of measuring antibiotic effect by uniform treatment of all sows within a house with that of separate treatment of individual sows within a house.

No beneficial effect of antibiotic was found in the first trial on experiment station farms where a combination of 166 mg. active neomycin and 166 mg. oxytetracycline per kg. feed was fed. When this combination or a combination of 110 mg. chlortetracycline, 110 mg. sulfamethazine, and 55 mg. procaine penicillin per kg. feed was fed on a commercial farm from the 109th day of gestation to the 10th day of lactation, the 28-day weaning weight of pigs was increased by 10 percent. The percentage of survival was greater but this difference was not statistically significant. Swabs taken from the anus and vagina at 0, 2, and 4 days after treatment started and the day following farrowing and incubated aerobically overnight on blood agar and eosin blue plates failed to show a qualitative change in microflora due to antibiotic treatment. Periodic sensitivity checks failed to show alteration in microorganism sensitivity.

In a third trial conducted on a commercial farm in Hawaii, when sows were fed tylosin, chlortetracycline, or a combination of 40% chlortetracycline, 40% sulfamethazine, and 20% procaine penicillin at a level of 500 mg. per sow daily and all sows within a given house received the same treatment, the weaning weight of pigs at 28 days was greater than that of pigs from control sows that had received no treatment. Only the difference due to the antibiotic combination, however, was statistically significant. Survival rate of pigs was also greater among the pigs from antibiotic-fed sows than those from untreated controls. These differences were significant in both tylosin- and combination-treated lots. When sows within the same house were divided into four groups and given the four treatments above, there were no significant differences in either survival rate or rate of gain of pigs.

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